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(54) **FIRE SUPPRESSION APPARATUS VALVE ASSEMBLY**

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CPC A62C 35/68; A62C 35/023; A62C 35/08; A62C 35/10; A62C 37/14
USPC 169/58, 19–22, 26–30, 71, 72, 74
See application file for complete search history.

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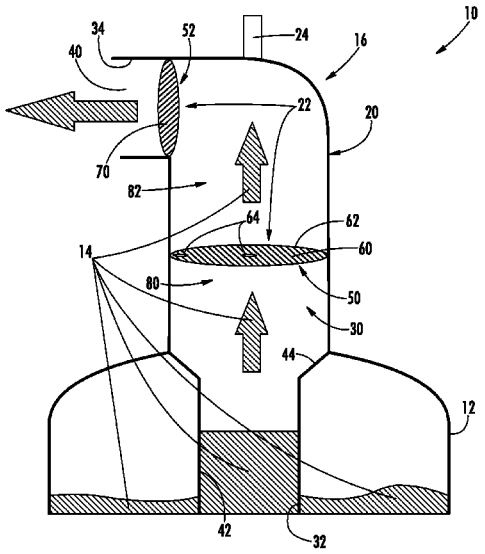
(57) **ABSTRACT**

A fire suppression apparatus includes a valve assembly connected to a container holding a fire suppressant. The valve assembly includes a valve body and a first disc. The valve body defines a passageway that extends between a first valve body end and a second valve body end. The first disc is disposed within the passageway. The first disc has a first disc body defining a perforation that extends completely through the first disc body.

10 Claims, 3 Drawing Sheets



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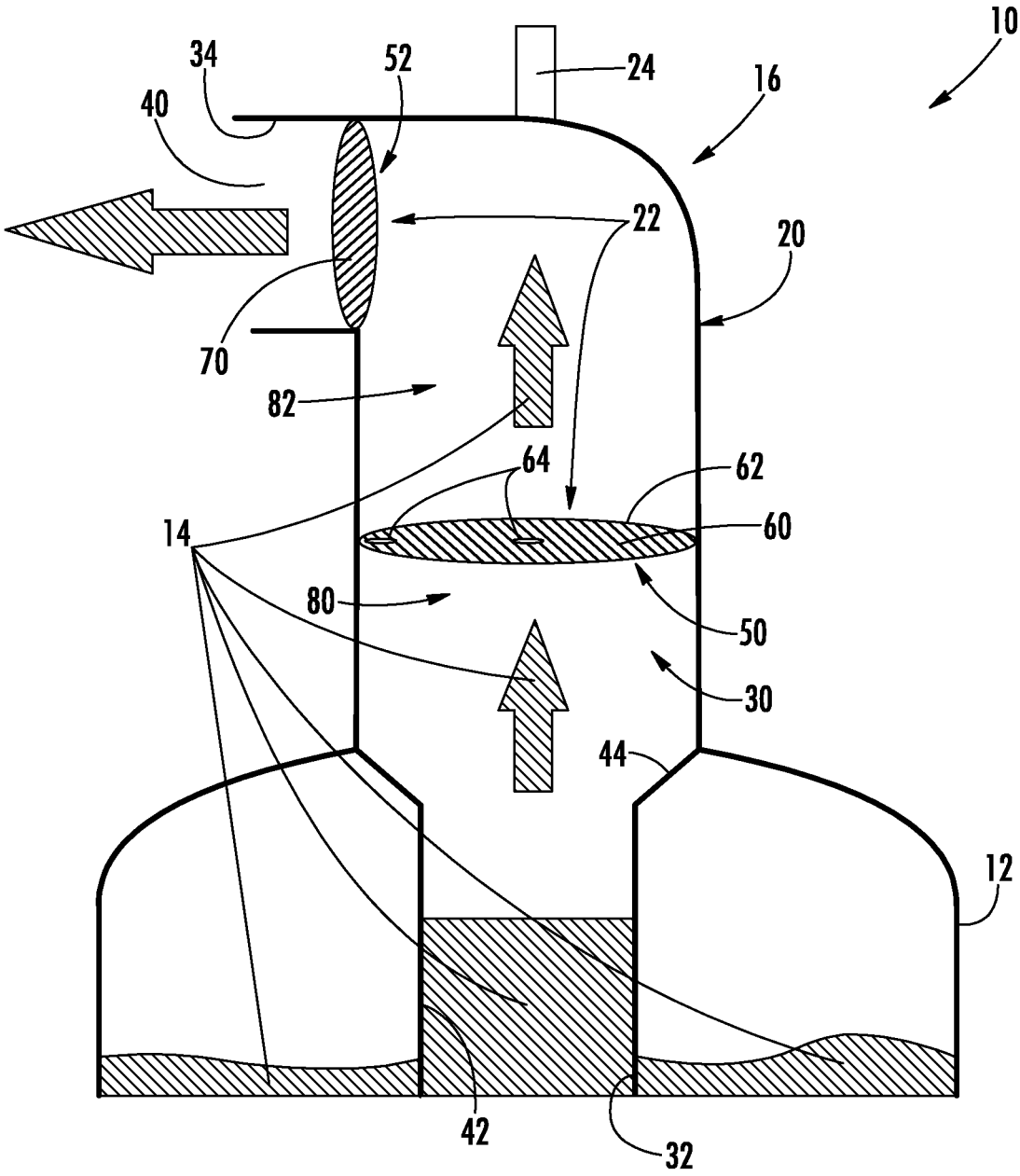

FIG. 1

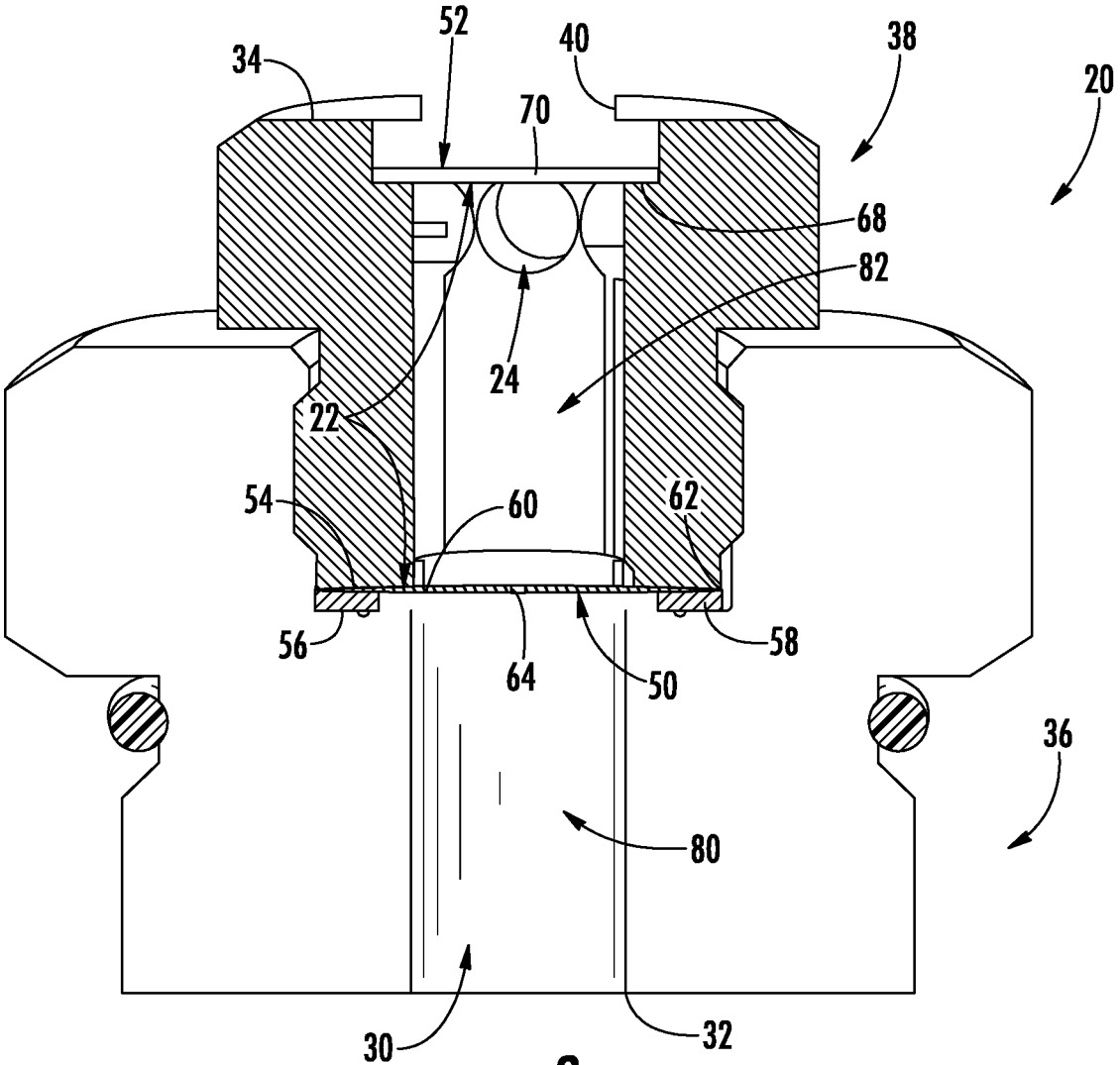

FIG. 2

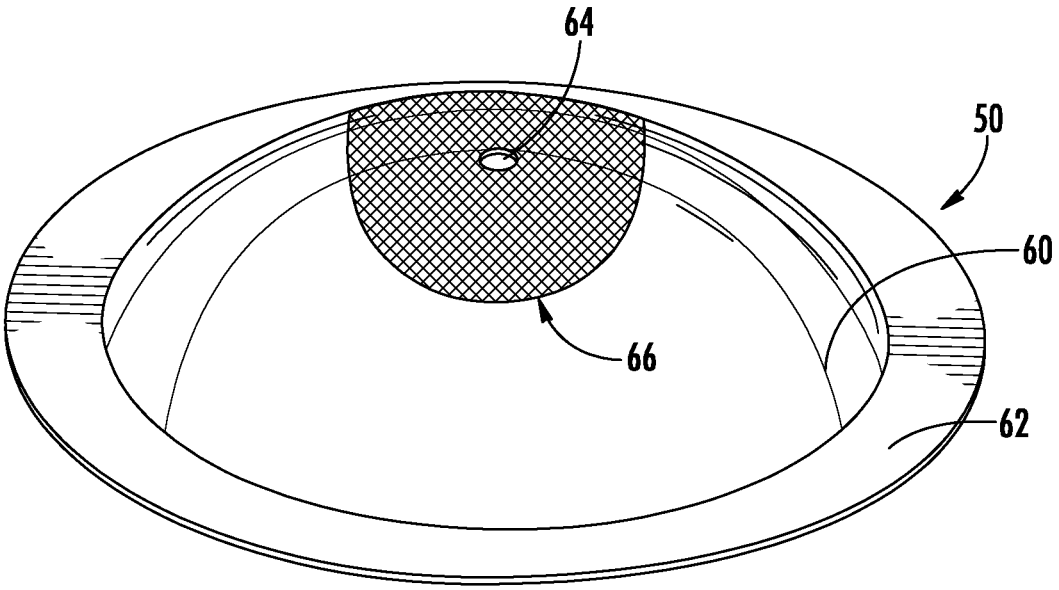

FIG. 3

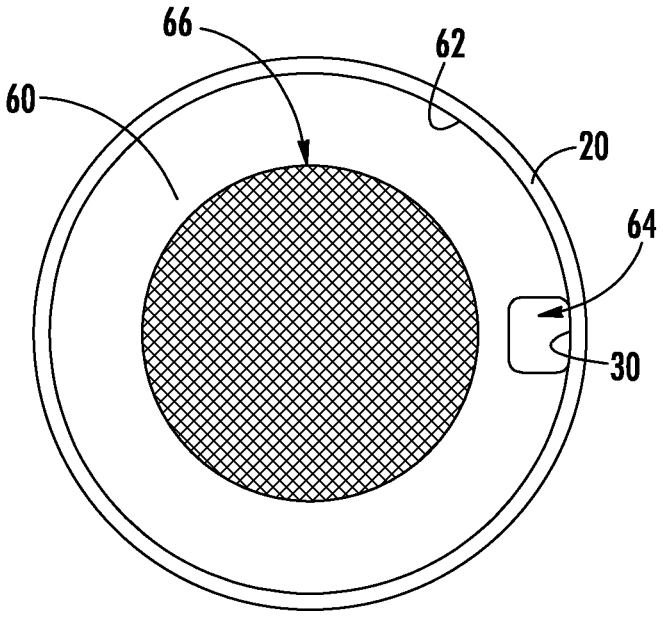

FIG. 4

FIRE SUPPRESSION APPARATUS VALVE ASSEMBLY

BACKGROUND

Fire extinguisher systems are arranged to rapidly disperse an extinguishing agent following a thermal event. Typically, the extinguishing agent is sealed within a bottle or a container and a piston assembly may be provided to balance pressure within the bottle or container.

SUMMARY

Disclosed is a fire suppression apparatus that includes a valve assembly connected to a container holding a fire suppressant. The valve assembly includes a valve body and a first disc. The valve body defines a passageway that extends between a first valve body end and a second valve body end. The first disc is disposed within the passageway. The first disc has a first disc body defining a perforation that extends completely through the first disc body.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the first disc is disposed between the first valve body end and the second valve body end.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the valve assembly further comprising: a second disc disposed within the passageway and disposed proximate the second end.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, a first chamber is defined between the first valve body end and the first disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, a second chamber is defined between the first disc and the second disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the perforation of the first disc is arranged to facilitate a pressure balance between the first chamber and the second chamber.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the passageway defines an inlet that extends from the first valve body end towards the first chamber.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the passageway defines a diffuser that extends between the inlet and the first chamber.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the inlet has a first cross-sectional form and the first chamber has a second cross-sectional form that is greater than the first cross-sectional form.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, a vent valve is arranged to evacuate the second chamber.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the second valve body end defines a discharge port within which the second disc is disposed.

Also disclosed is a fire suppression apparatus that includes a valve assembly having a valve body and a disc assembly. The valve body defines a passageway that extends between a first valve body end and a second valve body end. The disc assembly is disposed within the passageway and includes a first disc and a second disc. The first disc is disposed within the passageway and is disposed between the first valve body end and the second valve body end. The first disc includes a first disc body having a rim and defines a perforation that extends from the rim towards a center of the first disc body. The second disc is disposed within the passageway and is disposed proximate the second valve body end.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, a first chamber is defined between the first valve body end and the first disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, a second chamber is defined between the first disc and the second disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the perforation define a bleed path between the first chamber and the second chamber.

Further disclosed is a method of providing a valve assembly for a fire suppression apparatus. The method includes providing a first valve body member having a seating surface; disposing a first disc on the seating surface, the first disc having a perforation that extends completely through the first disc; providing a second valve body member having an end surface; and inserting the second valve body member into the first valve body member such that the end surface engages the first disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the perforation defines a bleed path between a first chamber that is defined between a first valve body end of the first valve body member and the first disc and a second chamber that is defined between a second valve body end of the second valve body member and the first disc.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, disposing a second disc on a disc seat defined by the second valve body member.

In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, inserting the first valve body member into a container holding fire suppressant.

These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the present disclosure is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the present disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a partial section view of a fire suppression apparatus having a valve assembly;

FIG. **2** is a partial section view of a valve body of the fire suppression apparatus;

FIG. **3** is a perspective view of a disc; and

FIG. **4** is a plan view of a disc.

DETAILED DESCRIPTION

Referring now to the Figures, where the present disclosure will be described with reference to specific embodi-

ments, without limiting the same, it is to be understood that the disclosed embodiments are merely illustrative of the present disclosure that may be embodied in various and alternative forms. Various elements of the disclosed embodiments may be combined or omitted to form further embodiments of the present disclosure. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present disclosure.

Referring to FIG. **1**, a fire suppression apparatus **10** is shown. The fire suppression apparatus **10** includes a container **12** (partially shown) that holds a fire suppressant **14**, and a valve assembly **16**.

The container **12** may be an extinguisher bottle or cylinder that receives the pressurized fire suppressant **14** or other extinguishing agent. The container **12** is fluidly connected to the valve assembly **16** that facilitates the delivery of the fire suppressant **14**, responsive to a thermal event. The fire suppressant **14** may be a liquid suppression agent or extinguishing agent.

The valve assembly **16** extends into the container **12** and is arranged to selectively facilitate a fluid flow of the fire suppressant **14** from the container **12** towards an environment in which a thermal event may be present. The valve assembly **16** includes a valve body **20**, a disc assembly **22**, and a vent valve **24**.

The valve body **20** defines a passageway **30** that extends between a first valve body end **32** and a second valve body end **34**. The first valve body end **32** extends into the container **12**. The second valve body end **34** is spaced apart from the container **12** and defines an outlet port or a discharge port **40**. The discharge port **40** is fluidly connected to a fluid delivery device such as an exit hose, discharge housing, or the like that may deliver or direct the fire suppressant **14** towards a thermal event.

Referring to FIG. **2**, the valve body **20** may be at least partially defined by a first valve body member **36** and a second valve body member **38**. The first valve body member **36** may extend into and be connected to the container **12**. The second valve body member **38** is at least partially received within the first valve body member **36**. The second valve body member **38** is arranged as a retainer that retains a disc of the disc assembly **22** between the first valve body member **36** and the second valve body member **38**. The first valve body end **32** may be defined by an end of the first valve body member **36** and the second valve body end **34** may be defined by the second valve body member **38**. The passageway **30** extends through and is defined by the combination of the first valve body member **36** and the second valve body member **38**.

Referring to FIG. **1**, the passageway **30** includes or defines an inlet **42**, a diffuser **44**, and in some embodiments, the discharge port **40**. The inlet **42** extends from a distal end of the first valve body end **32** towards the diffuser **44** and a first chamber **80**. The diffuser **44** extends between the inlet **42** and the first chamber **80**. The diffuser **44** provides an expansion between the inlet **42** and the remainder of the passageway **30**. The diffuser **44** is sized such that the inlet **42** has a first cross-sectional form and the remainder of the passageway **30** between the diffuser **44** and the discharge port **40** has a second cross-sectional form that is greater than the first cross-sectional form. In some embodiments, the diffuser **44** may not be provided such that the second cross-sectional form is generally equal to or less than the first cross-sectional form.

The disc assembly **22** is disposed within the passageway **30** of the valve body **20**. The disc assembly **22** may be provided in lieu of piston assemblies to balance a fluid pressure between the container **12** and the passageway **30** of the valve body **20**. The disc assembly **22** includes a first disc **50** and a second disc **52**.

The first disc **50** is disposed within the passageway **30** and is disposed between the first valve body end **32** and the second valve body end **34**. The first disc **50** extends completely across the passageway **30** and engages an inner surface of the valve body **20**. Referring to FIG. **2**, the first disc **50** is disposed between an end surface **54** of the second valve body member **38** and a seating surface **56** of the first valve body member **36**. A washer **58** is disposed on the seating surface **56** of the first valve body member **36** and is disposed between the first disc **50** and the seating surface **56**.

The first disc **50** may be made of a metallic material having good corrosion resistance such as nickel, copper, Monel, steel alloy, or the like. The first disc **50** may not be provided with a coating or a polymer layer to seal the first disc **50**.

Referring to FIGS. **3** and **4**, the first disc **50** includes a first disc body **60** having a rim **62**. The first disc body **60** may include a dome shaped portion that is circumscribed by the rim **62**. The dome shaped portion extends towards the first valve body end **32** or extends towards the second valve body end **34**. In at least one embodiment, the first disc body **60** may be a generally flat body or planar body. The first disc body **60** may be provided with a patterned portion or patterned region **66** to facilitate the bursting of the first disc **50** within a predetermined pressure or burst range. The patterned portion or patterned region **66** locally weakens the first disc **50** to encourage bursting or the first disc **50** within the patterned portion or patterned region **66**.

The rim **62** is disposed about the first disc body **60**. A circumferential edge of the rim **62** engages an interior surface of the passageway **30** of the valve body **20**.

The first disc body **60** defines a perforation **64** that extends completely through a center or a central region of the first disc body **60**, as shown in FIG. **3**, or the perforation **64** may extend from a circumferential edge of the rim **62** towards the center of the first disc body **60**, as shown in FIG. **4**. The perforation **64** extends completely through the first disc body **60** through the patterned portion or patterned region **66** and the perforation **64** in conjunction with the patterned portion or patterned region **66** facilitates or enables the first disc **50** to burst within a predetermined pressure or burst range. A coating, seal, or polymer layer does not extend across the perforation **64** such that perforation **64** is an opening free of any obstructions.

The perforation **64** arranges the first disc **50** as a semi-permeable disc valve. In at least one embodiment, multiple perforations **64** may be defined by the first disc body **60**.

The second disc **52** is disposed within the passageway **30** and is disposed between the first disc **50** and the second valve body end **34**. The second disc **52** may be disposed on a disc seat **68** of the second valve body member **38** that is disposed proximate the second valve body end **34**, as shown in FIG. **2**. The second disc **52** is disposed proximate the second valve body end **34** and in some embodiments, the second disc **52** is disposed within the discharge port **40**.

The second disc **52** includes a second disc body **70** that extends completely across the passageway **30** and engages

an interior surface of the valve body **20**. The second disc body **70** may not be provided with any perforations and may be a generally solid disc.

Referring to FIGS. **1** and **2**, a first chamber **80** is defined between the first valve body end **32** and the first disc **50**. A second chamber **82** is defined between the first disc **50** and the second disc **52**. The second chamber **82** may be a valve chamber that is separated from the pressurized container **12** by the first disc **50**. A portion of the passageway **30** within the second chamber **82** may define a bend that is located between the first disc **50** and the second valve body end **34**. The bend may be a 90° bend or turn, however other arrangements are also possible.

The perforation **64** of the first disc **50** is arranged to facilitate a pressure balance between the first chamber **80** and the second chamber **82**, such as due to temperature fluctuations that may vary a pressure within the first chamber **80** and/or the second chamber **82**. In such an arrangement, the perforation **64** of the first disc **50** defines a bleed path or leak path between the first chamber **80** and the second chamber **82** that facilitates the pressure balance between the first chamber **80** and the second chamber **82**, prior to a thermal event. The perforation **64** of the first disc **50** allows for the pressure on both sides of the first disc **50** to remain in equilibrium prior to a thermal event. The perforation **64** is sized to enable fluid communication between the first chamber **80** and the second chamber **82**.

The perforation **64** may have a cross-sectional form or cross-sectional diameter that is less than a thickness of the first disc **50**. In at least one embodiment, the perforation **64** may have a cross-sectional form or cross-sectional diameter that is greater than or equal to a thickness of the first disc **50**.

In at least one embodiment, the first disc **50** and the second disc **52** may be generally solid discs that are disposed within the passageway **30**. The second disc **52** may extend completely across the passageway **30**, blocking the discharge port **40**. The first disc **50** may define a discontinuity or a perforation **64** that extends from an edge of the rim **62** towards the center of the first disc body **60**. The discontinuity or perforation **64** may be disposed adjacent to and spaced apart from a patterned portion or patterned region **66** of the first disc **50**.

The vent valve **24** is connected to the valve body **20** and extends into the second chamber **82**. The vent valve **24** may be disposed between the first disc **50** and the second disc **52**. The vent valve **24** may be a controlled valve, such as a controlled Schrader valve, that is arranged to facilitate the evacuation of a fluid (e.g. vented fire suppressant **14** from the first chamber **80** to the second chamber **82** or vice versa) from within the second chamber **82** through the vent valve **24** to an external environment, responsive to a thermal event. The evacuation of the fluid from the within the second chamber **82** to an external environment reduces a fluid pressure within the second chamber **82** such that there is a pressure difference across the first disc **50**. The vent valve **24** may extend through the second valve body member **38**, as shown in FIG. **2**.

In at least one embodiment, the vent valve **24** may be disposed at the second valve body end **34** and the discharge port **40** may be disposed between the first disc **50** and the vent valve **24**. In such an arrangement, the second disc **52** may be disposed in the discharge port **40** such that the second disc **52** is disposed between the first disc **50** and the vent valve **24**. In such an arrangement, head losses within the second chamber **82** may be reduced by inhibiting the turning of the fire suppressant **14** within the second chamber **82** and allowing the fire suppressant **14** to flow straight through the passageway **30** therefore improving the delivery of the fire suppressant **14**.

The vent valve **24** evacuates the second chamber **82**, responsive to a thermal event. The evacuation of the second chamber **82** via the vent valve **24** results in a reduction of the pressure within the second chamber **82** such that a pressure difference across the first disc **50** or between the first chamber **80** and the second chamber **82**, exceeds a threshold pressure difference, causing the flow of the fire suppressant **14** to burst the first disc **50**. The bursting of the first disc **50** allows the fire suppressant **14** to enter the inlet **42**, expand through the diffuser **44**, and flow into the second chamber **82** where a rapid deceleration within the second chamber **82** may utilize the hammer effect or water hammer effect to burst the second disc **52** and facilitate the delivery of the fire suppressant **14** through the discharge port **40**.

The arrangement of the disc assembly **22** may replace a piston assembly and punch pin, thus reducing the overall cost of the fire suppression apparatus **10** while also providing a more robust valve assembly **16** with minimal moving parts because pressure differences burst the first disc **50** and the water hammer effect bursts the second disc **52** instead of mechanical devices. The disc assembly **22** replaces a piston assembly with a perforated disc to balance fluid pressures between chambers of the fire suppression apparatus **10** due to ambient temperature changes. Post-actuation of the fire suppression apparatus **10**, rebuilds of the fire suppression apparatus **10** may be easier to perform and less expensive by simply replacing the disc assembly **22** instead of replacing piston assemblies.

A method of providing a valve assembly **16** for the fire suppression apparatus **10** according to the following method. Providing the first valve body member **36**. Disposing the washer **58** on the seating surface **56** of the first valve body member **36**. Providing the first disc **50** having the perforation. Disposing the first disc **50** having the perforation **64** on at least one of the seating surface **56** of the first valve body member **36** or on the washer **58**. Providing the second valve body member **38**. Inserting the second valve body member **38** into the first valve body member **36** such that the end surface **54** of the second valve body member **38** engages the first disc **50**. Providing the second disc **52**. Disposing the second disc **52** on the disc seat **68** of the second valve body member **38** such that the second disc is disposed within the second valve body member **38**. Inserting the vent valve **24** onto or into the second valve body member **38**. Inserting the first valve body member **36** into the container **12** such that the valve assembly **16** (e.g. the valve body **20**, the disc assembly **22**, and the vent valve **24**) is installed onto the container **12**.

Replacement of the disc assembly **22** may be performed according to the following method. Removing the second valve body member **38** from the first valve body member **36**. Removing the burst first disc **50** from within the first valve body member **36**. Disposing the first disc **50** having the perforation **64** onto at least one of the washer **58** or the seating surface **56** of the first valve body member **36**. Removing the burst second disc **52** from the second valve body member **38**. Disposing the second disc **52** onto the disc seat **68** of the second valve body member **38**. Inserting the second valve body member **38** into the first valve body member **36** such that the end surface **54** of the second valve body member **38** engages the first disc **50**. Inserting the first valve body member **36** into the container **12** such that the valve assembly **16** (e.g. the valve body **20**, the disc assembly **22**, and the vent valve **24**) is installed onto the container **12**.

While the present disclosure has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the present disclosure is not limited to such disclosed embodiments. Rather, the present disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the present disclosure. Additionally, while various embodiments of the present disclosure have been described, it is to be understood that aspects of the present disclosure may include only some of the described embodiments. Accordingly, the present disclosure is not to be seen as limited by the foregoing description.

What is claimed is:

1. A fire suppression apparatus, comprising:

a valve assembly connected to a container holding a fire suppressant, the valve assembly including:

a valve body defining a passageway that extends between a first valve body end and a second valve body end, and

a first disc disposed within the passageway, the first disc having a first disc body defining a perforation that extends completely through the first disc body, the first disc having a planar body extending completely across the passageway;

a second disc disposed within the passageway and disposed between the first disc and the second valve body end, the second disc having a planar body extending completely across the passageway;

wherein a first chamber is defined within the passageway between the first valve body end and the first disc;

wherein a second chamber is defined within the passageway between the first disc and the second disc.

2. The fire suppression apparatus of claim **1**, wherein the first disc is disposed between the first valve body end and the second valve body end.

3. The fire suppression apparatus of claim **1**, wherein the perforation of the first disc is arranged to facilitate a pressure balance between the first chamber and the second chamber.

4. The fire suppression apparatus of claim **3**, wherein the passageway defines an inlet that extends from the first valve body end towards the first chamber.

5. The fire suppression apparatus of claim **4**, wherein the passageway defines a diffuser that extends between the inlet and the first chamber.

6. The fire suppression apparatus of claim **5**, wherein the inlet has a first cross-sectional form and the first chamber has a second cross-sectional form that is greater than the first cross-sectional form.

7. The fire suppression apparatus of claim **1**, further comprising: a vent valve that is arranged to evacuate the second chamber.

8. The fire suppression apparatus of claim **1**, wherein the second valve body end defines a discharge port within which the second disc is disposed.

9. A fire suppression apparatus, comprising:

a valve assembly, comprising:

a valve body defining a passageway that extends between a first valve body end and a second valve body end; and

a disc assembly disposed within the passageway, the disc assembly comprising:

a first disc disposed within the passageway and disposed between the first valve body end and the second valve body end, the first disc includes a first disc body having a rim and defines a perforation that extends from the rim towards a center of the first disc body, the first disc having a planar body extending completely across the passageway; and

a second disc disposed within the passageway and disposed between the first disc and the second valve body end, the second disc having a planar body extending completely across the passageway;

wherein a first chamber is defined within the passageway between the first valve body end and the first disc;

wherein a second chamber is defined within the passageway between the first disc and the second disc.

10. The fire suppression apparatus of claim **9**, wherein the perforation defines a bleed path between the first chamber and the second chamber.

* * * * *